Claims

1. (Original) A method of canceling ghost artifacts in magnetic resonance imaging to produce an image or series of images, comprising:

acquiring data using an array of receiver coils in a magnetic resonance environment, wherein the data is acquired using a phase encode order in which k-space distortion has components which are substantially periodic;

converting the data to the image domain to produce images with ghost artifacts; and

canceling the ghost artifacts using phased array ghost cancellation processing to produce an image or series of images with ghost artifacts removed.

2. (Original) The method of claim 1, wherein the acquired data is k-space data.

3. (Previously presented) The method of claim 1, wherein the converting comprises using a fast Fourier transform.

4. (Previously presented) The method of claim 1, wherein the phase encode order is designed such that the k-space distortion has a rapid periodic variation, thereby trading what would be an image blurring for image ghosts which can then be canceled by the phased array ghost cancellation processing.

5. (Previously presented) The method of claim 1, wherein the phased array ghost cancellation processing includes passing the images with the ghost artifacts through two or more phased array combiners coupled in parallel.

6. (Previously presented) The method of claim 5, further including aligning separated ghost images by shifting at least one image either prior to phased array combining or following phased array combining.

7. (Original) The method of claim 5, wherein the phased array combiners receive an image for each receiver coil and combine the images from the receiver coils into a single image.

8. (Previously presented) The method of claim 5, further including combining each of the single images received from the phased array combiners into a final output image.

9. (Original) The method of claim 1, wherein using phased array ghost cancellation processing includes using a plurality of phased array combiners coupled in parallel and the method further includes adaptively calculating phased array combiner complex coefficients.

10. (Original) The method of claim 1, further including using a phase encode order that is varied in time to achieve periodic distortion which is time varying in a manner that enables calculating a lower time resolution image without ghost artifacts.

11. (Original) The method of claim 10, wherein a ghost suppressed image is obtained for the purpose of adaptively calculating phased array combiner coefficients for ghost cancellation.

12. (Previously presented) The method of claim 5, further including combining outputs of the two or more phased array combiners using an output combiner and adaptively computing the output combiner's coefficients as the output combiner is outputting the series of images.

13. (Previously presented) The method of claim 1, further including temporally filtering to further suppress ghost artifacts.

14. (Previously presented) A system for canceling ghost artifacts in magnetic resonance imaging to produce an image or a series of images, comprising:

an image reconstructer that receives k-space data and converts the k-space data to the image domain;

a plurality of array combiners coupled to the image reconstructer, the array combiners being coupled in parallel;

at least one shifter coupled in series between one of the array combiners and the image reconstructer; and

an output combiner coupled to each of the array combiners that provides the series of images.

15. (Previously presented) The system of claim 14, further including a processor for adaptively calculating array coefficients for the array combiners.

16. (Previously presented) The system of claim 14, further including a processor for adaptively calculating combiner coefficients for the output combiner.

17. (Previously presented) The system of claim 14, further including multiple coils placed near a target to be imaged that receive k-space data representative of the target in the frequency domain and pass the data to the image reconstructer.

18. (Original) The system of claim 14, wherein the at least one shifter includes a first shifter and further including at least a second shifter coupled in series with an array combiner, the second shifter coupled in parallel with the first shifter.

19. (Original) The system of claim 14, wherein the at least one shifter includes N_G -1 shifters coupled in parallel, where N_G is a number of ghost artifacts in images produced by the image reconstructer, each shifter coupled between one of the array combiners and the image reconstructer.

20. (Original) The system of claim 14, wherein the array combiners combine images on a pixel-by-pixel basis and wherein the pixels have a complex weighting.

21. (Original) The system of claim 14, wherein the output combiner is a coherent combiner and wherein the pixels of the images being combined have a complex weighting associated therewith.

22. (Previously presented) The system of claim 14, wherein the array combiners produce a weighted image $h_i(x,y)f(x,y)$, where i is an integer number associated with the array combiner, $h_i(x,y)$ is a space-variant point spread function and f(x,y) is a desired image.

23. (Original) The system of claim 14, further including a temporal filter coupled in series with at least one of the array combiners to further suppress ghost artifacts.

24. (Original) A system for canceling ghost artifacts in magnetic resonance imaging to produce a series of images, comprising:

means for acquiring data using an array of receiver coils in a magnetic resonance environment, wherein the data is acquired using a phase encode order which causes k-space distortion to be periodic with a period corresponding to widely spaced ghost artifacts;

means for converting the data to the image domain to produce images which have ghost artifacts; and

means for canceling the ghost artifacts using phased array ghost cancellation processing to produce a series of images with ghost artifacts removed.

25. (Original) The system of claim 24, further including temporal filtering means coupled in series with the phased array ghost cancellation processing to further suppress ghost artifacts.

26-27. (Canceled)

28. (Original) A method of canceling ghost artifacts in magnetic resonance imaging to produce an image or series of images, comprising:

acquiring data using an array of receiver coils in a magnetic resonance environment, wherein the data is acquired using a phase encode order in which k-space distortion has components which are substantially periodic;

converting the data to the image domain to produce images with ghost artifacts; and

canceling the ghost artifacts using at least one phased array combiner that receives the image domain data and produces an image or series of images with ghost artifacts removed.

29. (Original) The method of claim 28, further including a temporal filter coupled in series with the at least one phased array combiner to further suppress ghost artifacts.

30. (Previously presented) The method of claim 29, further including adaptively calculating coefficients for the phased array combiner.

31. (Original) The method of claim 28, wherein the data is acquired using a time-varying phase encode order.

32. (Previously presented) The method of claim 1, wherein canceling comprises a constrained optimization that optimizes signal-to-noise ratio subject to the constraint of nulling a ghost artifacts at a known location.

33. (Previously presented) The method of claim 1, wherein the data is acquired based on multi-shot echo planar imaging with non-interleaved phase encode acquisition.

34. (Previously presented) The system of claim 14, wherein the phase encode order is a non-interleaved phase encode order with an echo train length ETL, and the known fixed spacing is equal to FOV/ETL, wherein FOV is a field of view.